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This report describes equipment purchased and research conducted under a grant issued under the University Research Instrumentation Program. The objective of the project was to evaluate the effectiveness of a computing programming setting in which a wide variety of computer hardware exists.

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FINAL REPORT

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Principal Investigator: Dr. Arthur M. Jones

Background

The object of this project was to evaluate the effectiveness of a computer programming setting in which a wide variety of computer hardware exist. Such a setting, of course, is in no way unusual,to the contrary, it may in fact represent the norm . But because the criteria used generally to select hardware include a host of factors other than machine performance, environments such as that described above will continue to exist as long as there remains a variety of hardware in the marketplace. This project was intended as an experiment in making the most of that variety within the context of an organization which engages in research/production activities.

Project activities were conducted on a minicomputer (DEC VAX 11/780) and a variety of microcomputers. Equipment was selected and environments were structured to resolve the following issues:

1) whether the acquisition of a software-specific microcomputer rather than a general-purpose one can be cost-effective;
2) whether a network of microcomputers can provide a program production environment alternative to the minicomputer;
3) whether a useful alternative microcomputer programming environment can be embedded within a minicomputer;
4) whether microcomputers on the low end of the price range could provide an adequate programming environment.

Hardware Environments

The software/applications-specific machines selected were the Tandy- 1000 personal computer with the DeskMate software; the Fujitsu Micro 16s with the multi-user CP/M operating system; the Corvus harddisk for use with Apple II's; the MacIntosh, for its unique style of operation ; the IBM PC portable and the Compaq Plus, for portability; the Novell Advanced Netware/86 for PC networking; and the Hewlett Packard Plotter for hard copies of computer graphics.

The IBM PC/XT and the Compaq Deskpro were selected as general-purpose microputers. Because of the wealth of software available for the Apple II, it too was studied for general applications.

Findings

The software- or applications-specific machine seems most appropriate when the user is inexperienced in the problem domain at hand. Such a machine should be functional,without frills, but simple to operate. The value of this equipment is not diminished even when its functionality is limited to the requirements of the task to be performed. In fact, machine functionality should be treated as being positively correlated with the level of the user's experience and confidence.

That the productivity of the more machine- facile programmer will significantly exceed that of his less skillful counterpart, all other factors being equal, portends handsome cost/time benefits to a planned effort to match the machine to the task and/or worker.

It should be noted that most of the operating systems resident on microcomputers today permit the knowledgeable user to create a task-specific programming environment for those machines. The higher initial cost of this alternative should weighed against the likelihood that the extra computer features will eventually be used to an extent justifying the excess cost.

What then are disadvantages of using the task-specific computers? If they are comparatively cheap and often enhance the productivity of the user, then why are they not always be the machine of choice?

The principal problem with a software specific machine is that as the user becomes more highly skilled the computer's limitations tends to interfer with his productivity. The general purpose computer is an appropriate replacement for the specialty machine in this situation. Such a machine can provide the flexibility and power necessary to compliment the creative powers of a skilled user.
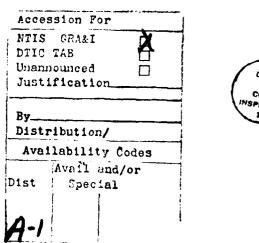
Of all the environments studied, none were as supportive of programmer productivity as that provided by two Apple II microcomputers and a Corvus harddisk with the UCSD/Pascal operating system. In that environment, two student programmers developed a program composed of twenty-eight (28) compilation units comprising thirty-seven hundred (3,700) lines of high quality Pascal code, during a five month project. Much of the credit for that accomplishment must be given to the UCSD/Pascal

operating system. Configuration and file management were both simplified by features of that operating system. The UCSD P-system is also highly recommended for applications when machine independence is a goal. One student assistant, who had no prior experience with the program described above, single-handedly ported the 3,700 lines of code to an IBM-PC environment over a 2.5 month period of time. The UCSD P-system for the IBM-PC was surprisingly compatible with that for the Apple II.

The Bridge Z-Board provided a useful PC environment on the VAX 11/780 minicomputer. This environment's usefulness however may be best suited for small applications. Because many languages today support some form of separate compilation, this limitation is more a problem of management than a technical one. Most MS-DOS or CP/M based software runs under this product but the programmer's workspace is limited to 256 kbytes.

Our application centered on developing code and system documentation on the VAX and, then, downloading files to a PC. The experiment proved that a "for PC" development can be performed without PC hardware.

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